



Simulations and Validation

Evan Fishbein

AIRS Science Team Meeting
Solvang, CA

2 May 2002



What Role Will Simulations Have After Launch?

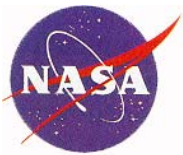


- Do simulations have a role in validation?
 - Simulated data is supplemented forecast/analysis - how valid is forecast/analysis?
- Do we need simulated data if we have the real thing (algorithm development)?
 - Simulated radiances correspond to perfectly-known geophysical states.
 - Are simulated data sufficiently realistic
 - global variability, i.e distribution of geophysical states
 - local variability, i.e distribution within retrieval states

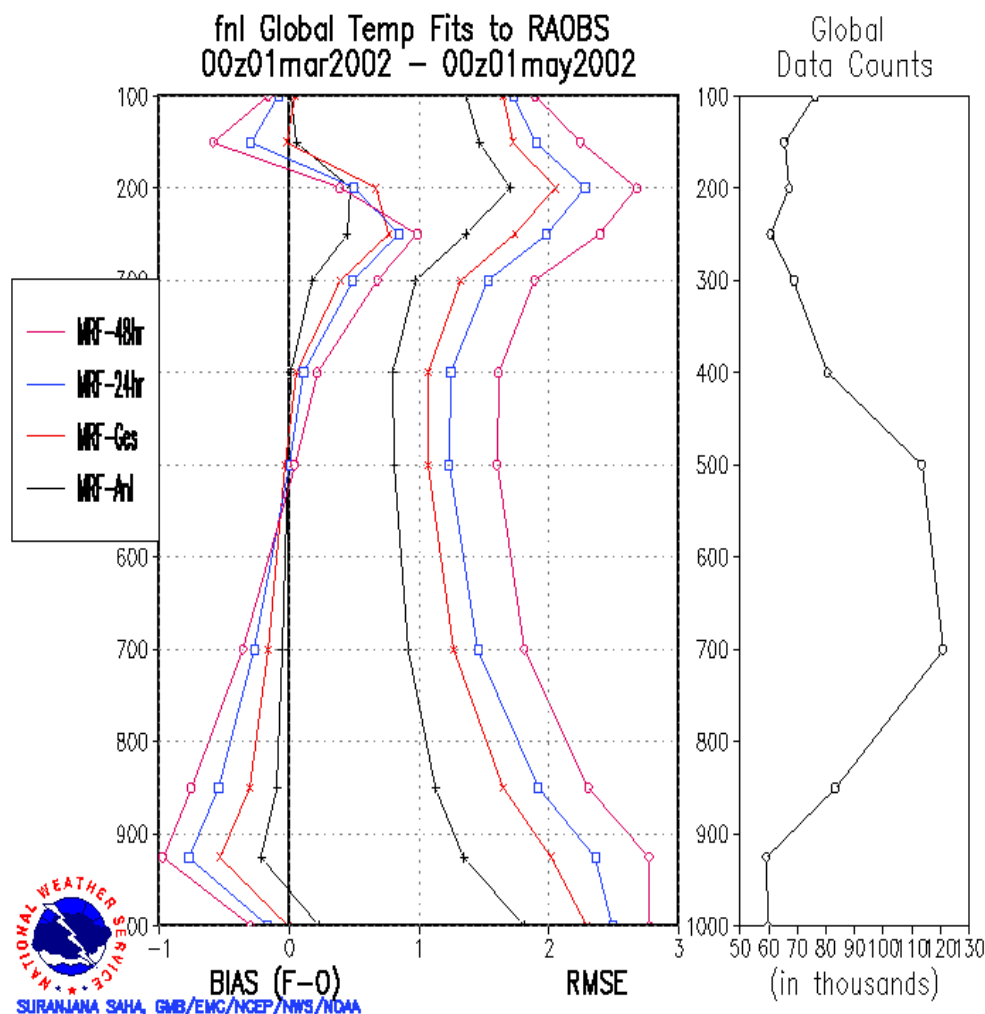


Analysis/Forecast Data Validity

- Plentiful, but what are its error characteristics
- More accurate/precise data will take time to collect
- Use it for bootstrapping at early stages of validation
 - deprecate as more accurate/precise data are collected
 - calculate radiances to identify clear footprints
- Identify problems in analysis where AIRS can make an impact



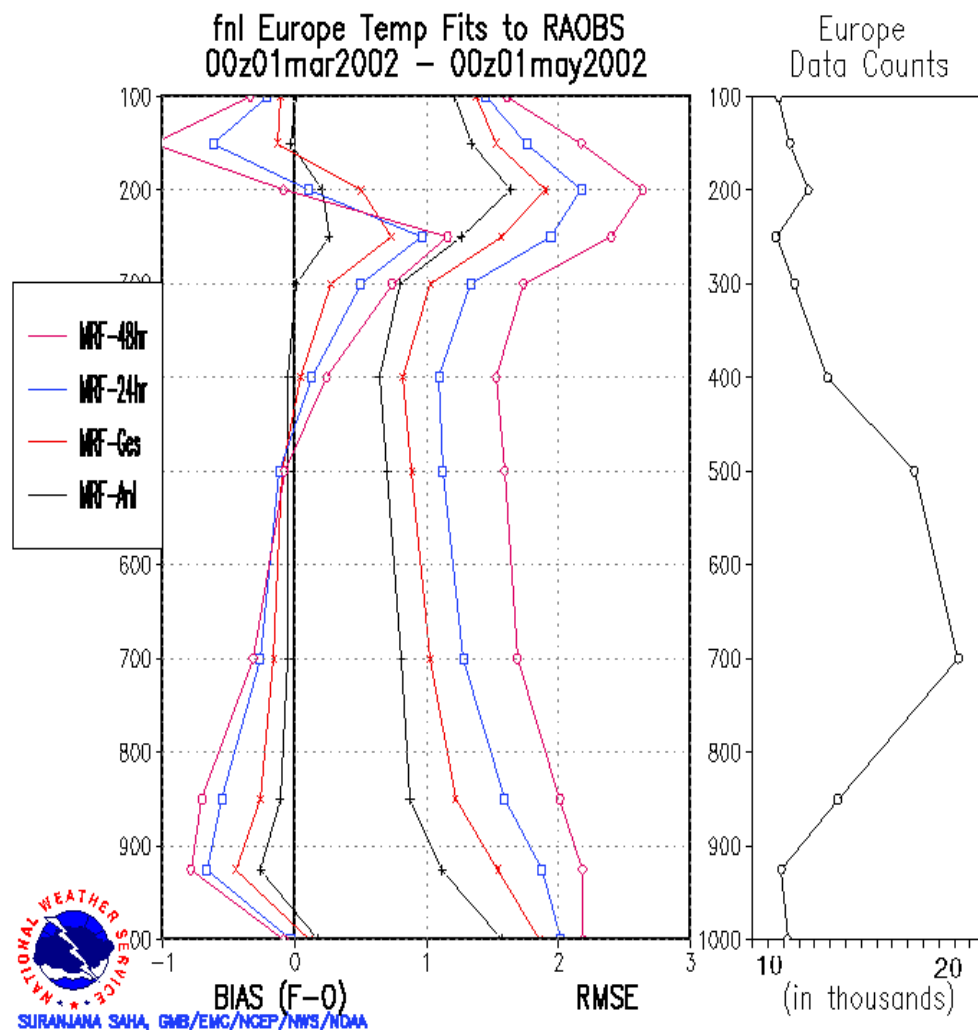
RAOBS - Forecast Intercomparison (Global)



SURANJANA SAHA, GMB/EMC/NCEP/NWS/NOAA

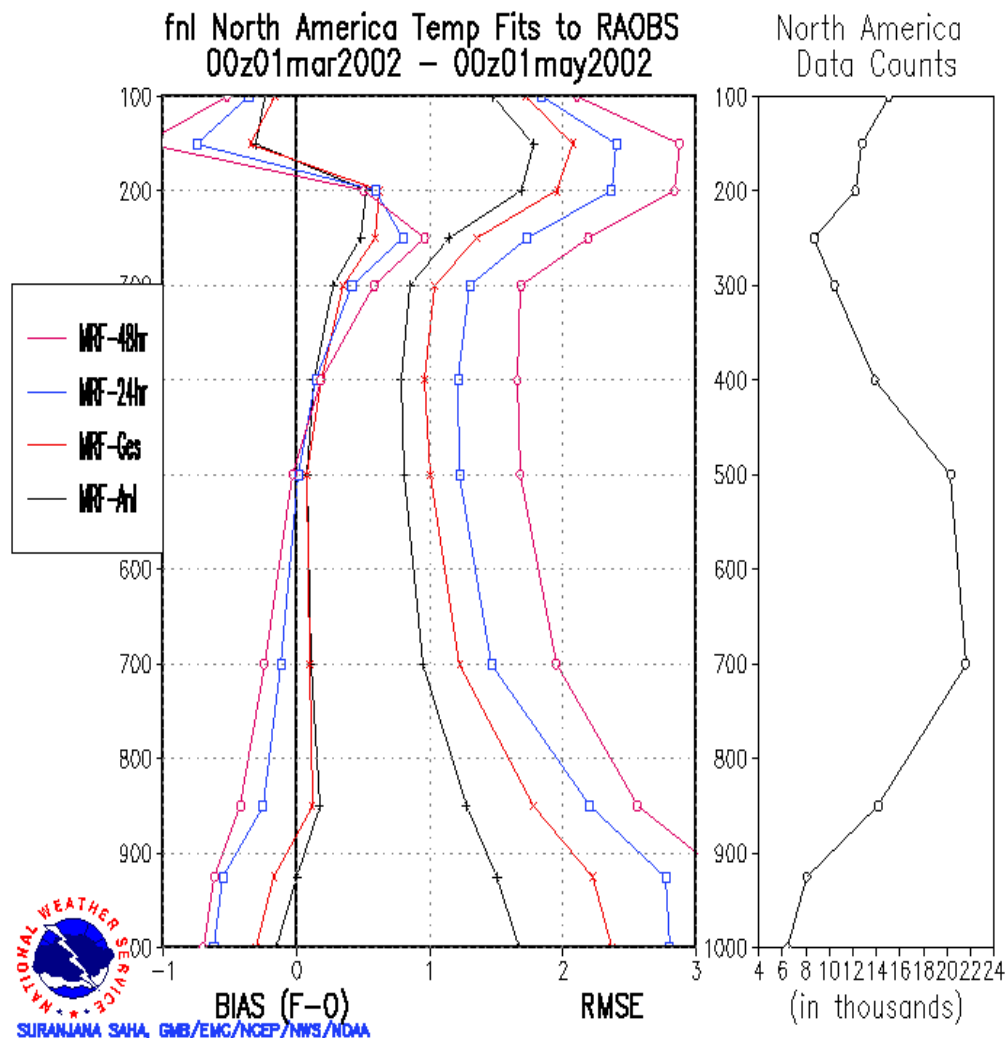


RAOBS - Forecast Intercomparison (Europe)



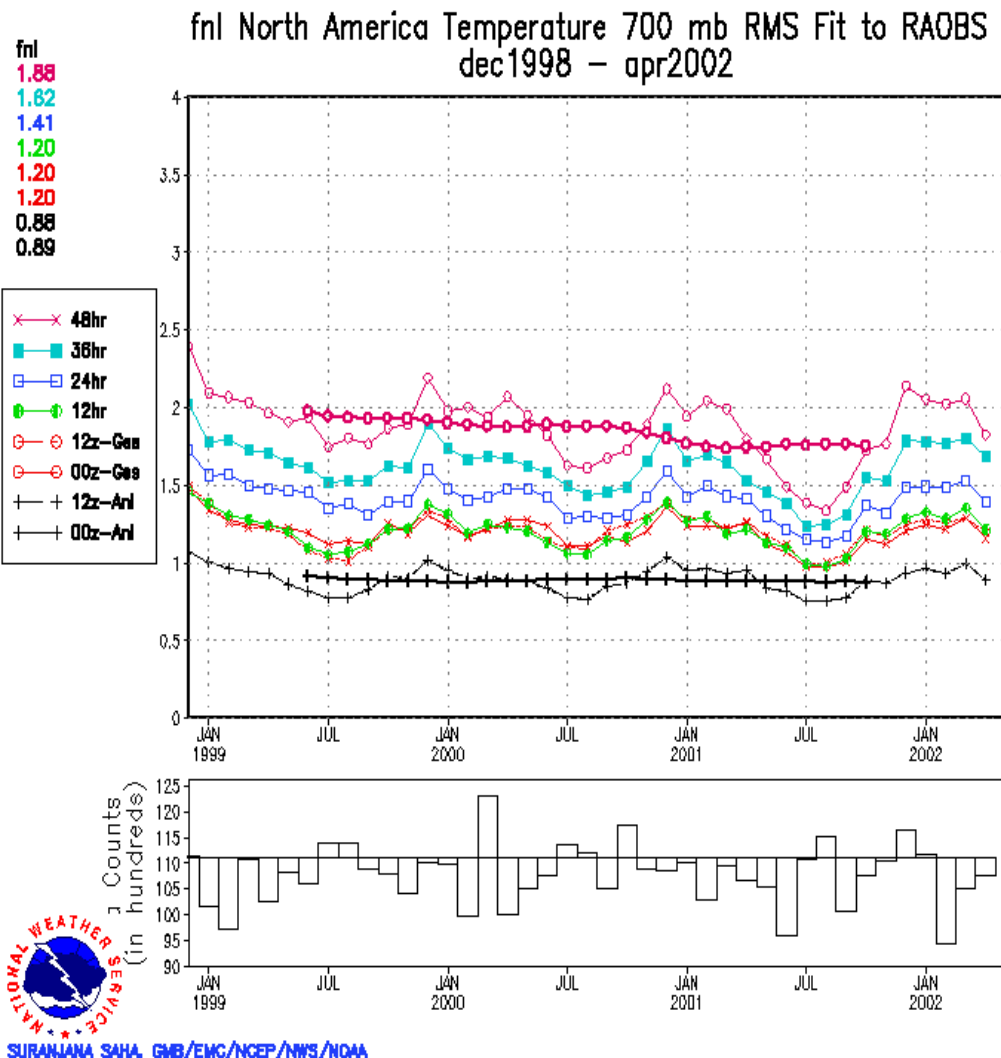


RAOBS - Forecast Intercomparison (N. America)





Analysis/Forecast Time Series over North America





Analysis/Forecast over SGP RMS Differences

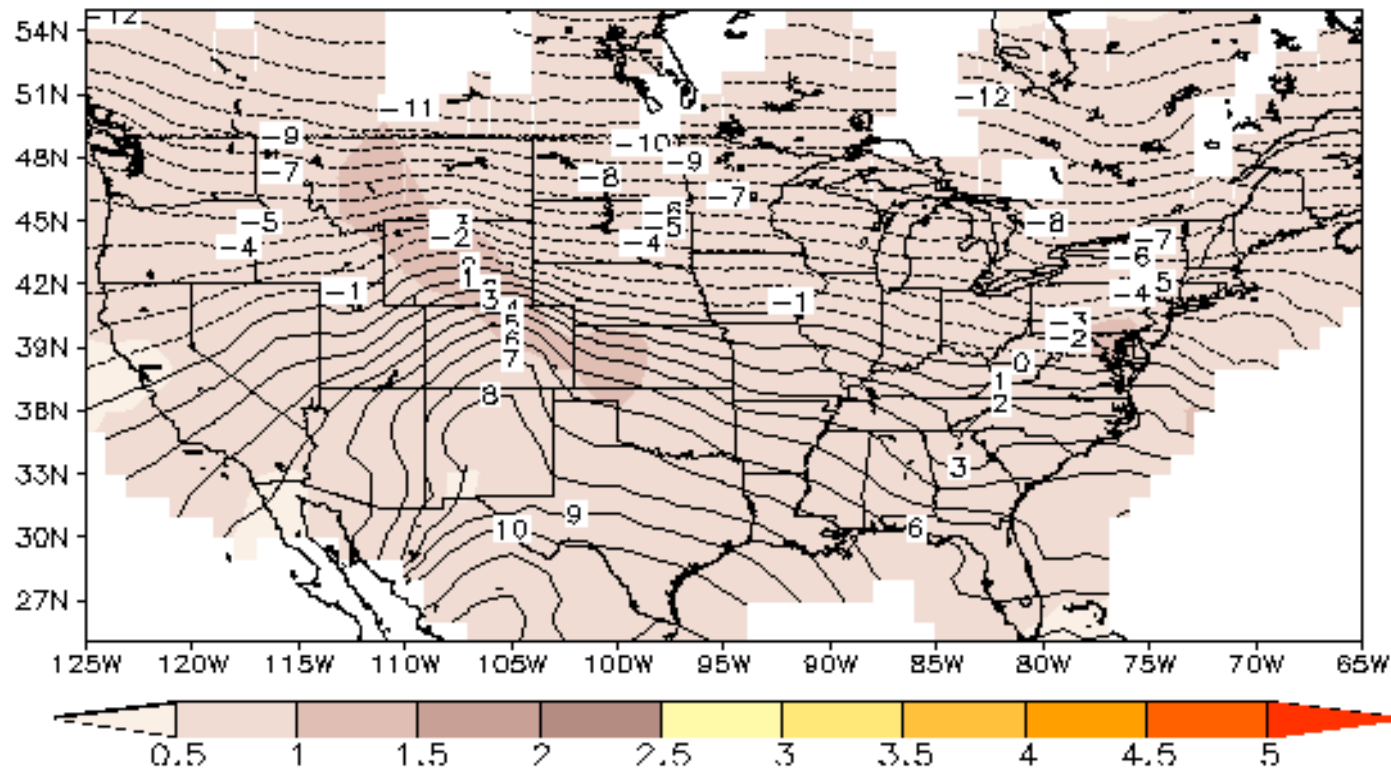


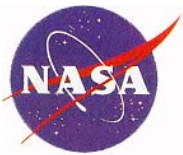
Temp 700 mb ANALYSIS RMS Error in Celsius
from 00z01apr2002-00z01may2002

FNL-OBS : Station Count 83 RMS 0.74



SURANJANA SAHA, GMB/EMC/NCMP/NWS/NOAA





Surface Temperature Data Marine

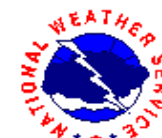


00Z01MAY2002 AVN Temperature Coverage from MARINE_ALL

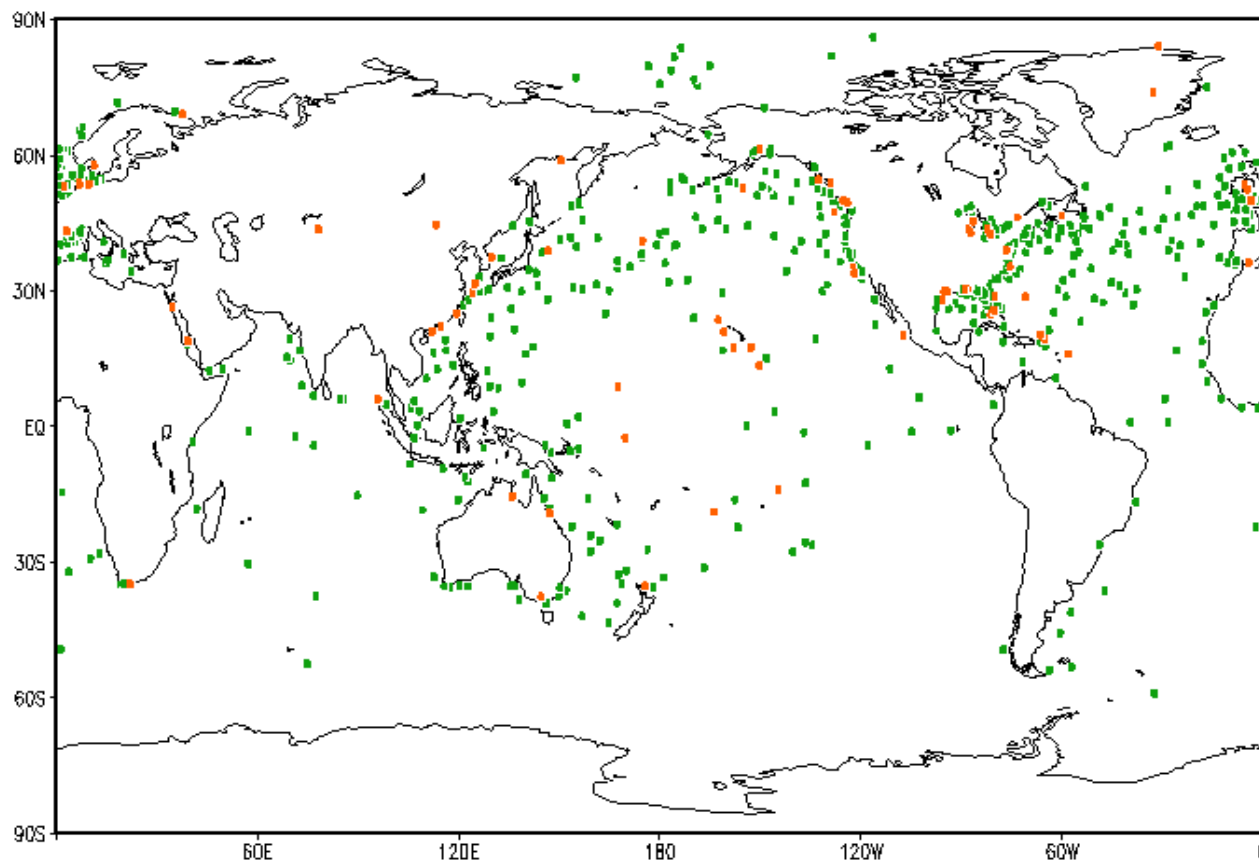
Accepted 569

Rejected 78

Type 180



SURANJANA SAHA, GMB/EMC/NCEP/NWS/NOAA





Surface Temperature Data Land



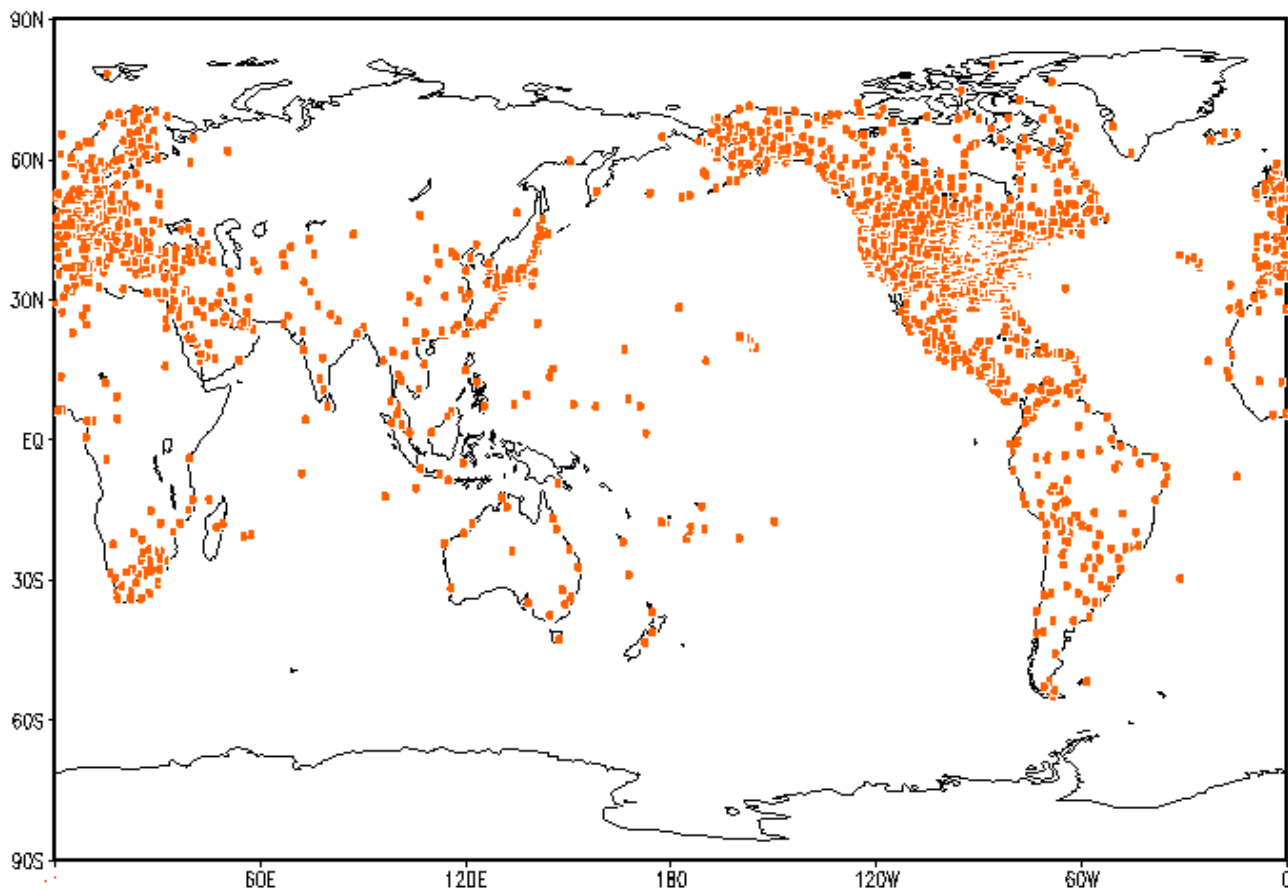
00Z01MAY2002 STATIONS Temperature Coverage from METAR

Accepted 0

Rejected 21634 Type 187



SURANJANA SAHA, GMB/EMC/NCEP/NWS/NOAA





RAOBS - Forecast General Observations



- RMS Temperature Differences are less than 1K

Globally	800 hPa to 300 hPa
North America	750 hPa to 300 hPa
Europe	900 hPa to 275 hPa

- Average Temperature Differences are less than 0.25K from 900hPa to 300 hPa
- Forecast/Analysis are poor near the surface
 - Analysis rejects land surface data
 - Surface model not consistent with observations



RAOBS - Forecast General Observations (cont)



- Errors are uniform over North America
 - Can it be used to extrapolate from SGP site to cloud free locations?
- When forecast/analysis and radiosonde disagree
 - reject analysis/forecast or radiosonde?
- Forecast/Analysis are poor near the surface
 - Analysis rejects land surface data
 - Surface model not consistent with observations
- Assimilation centers have experience with validation data error characteristics
 - Help with validation data quality control
 - Can they help with quality control of research data, e.g. lidar, ARM CART... and water vapor products?



Simulated Data and Algorithm Development

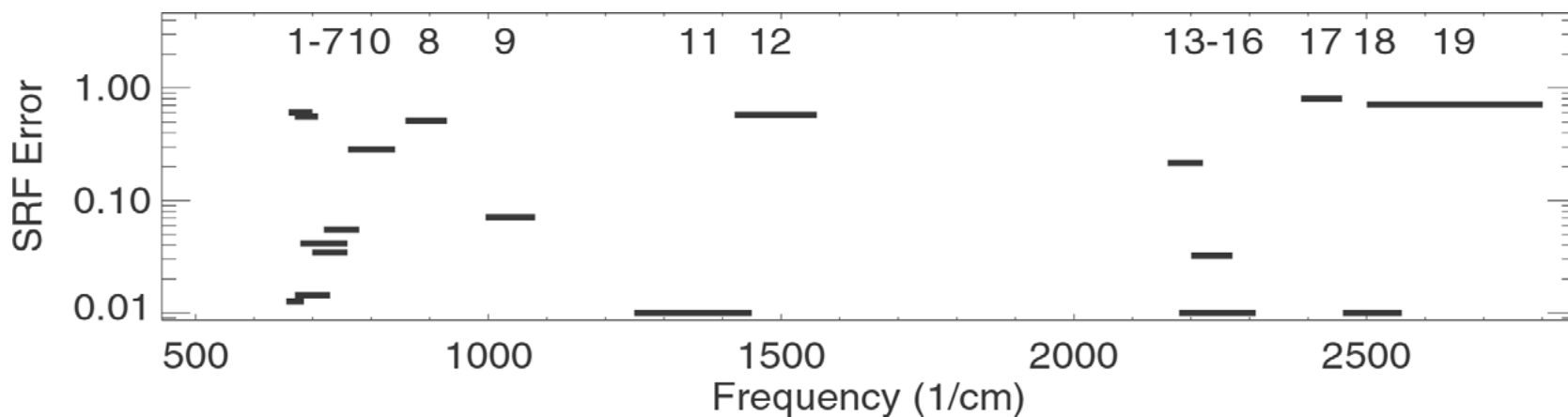
- Is simulated data sufficiently realistic for further algorithm development?
- What other options?
 - Calculate radiances from ensemble of retrieved states
 - is this necessarily more realistic given quality of forecast?
 - Will retrievals be robust early enough (bootstrap issue)
 - Compare statistics of radiances and simulated radiances, adjust the second to agree



Simulated Radiance Validation (IEEE Paper)



- Compare HIRS2 Radiances from NOAA 14 with reconstructed radiances
- Fit HIRS2 SRF with weighted sum of AIRS SRF

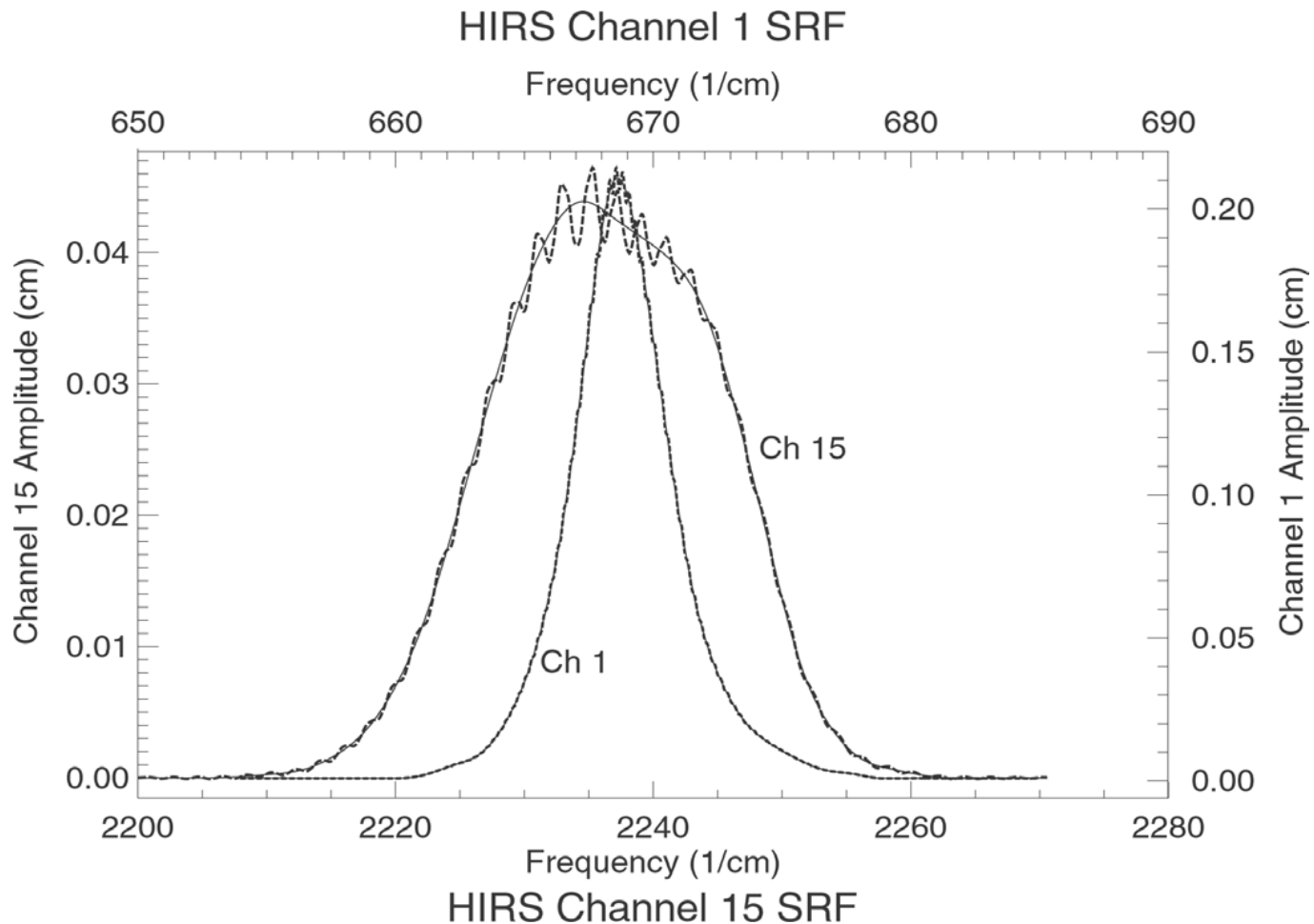


- 3 hour local time later

$$\epsilon_i^2 = \frac{1}{2} \int \left(S_H(\nu, i) - S_H^{\text{Fit}}(\nu, i) \right)^2 d\nu$$

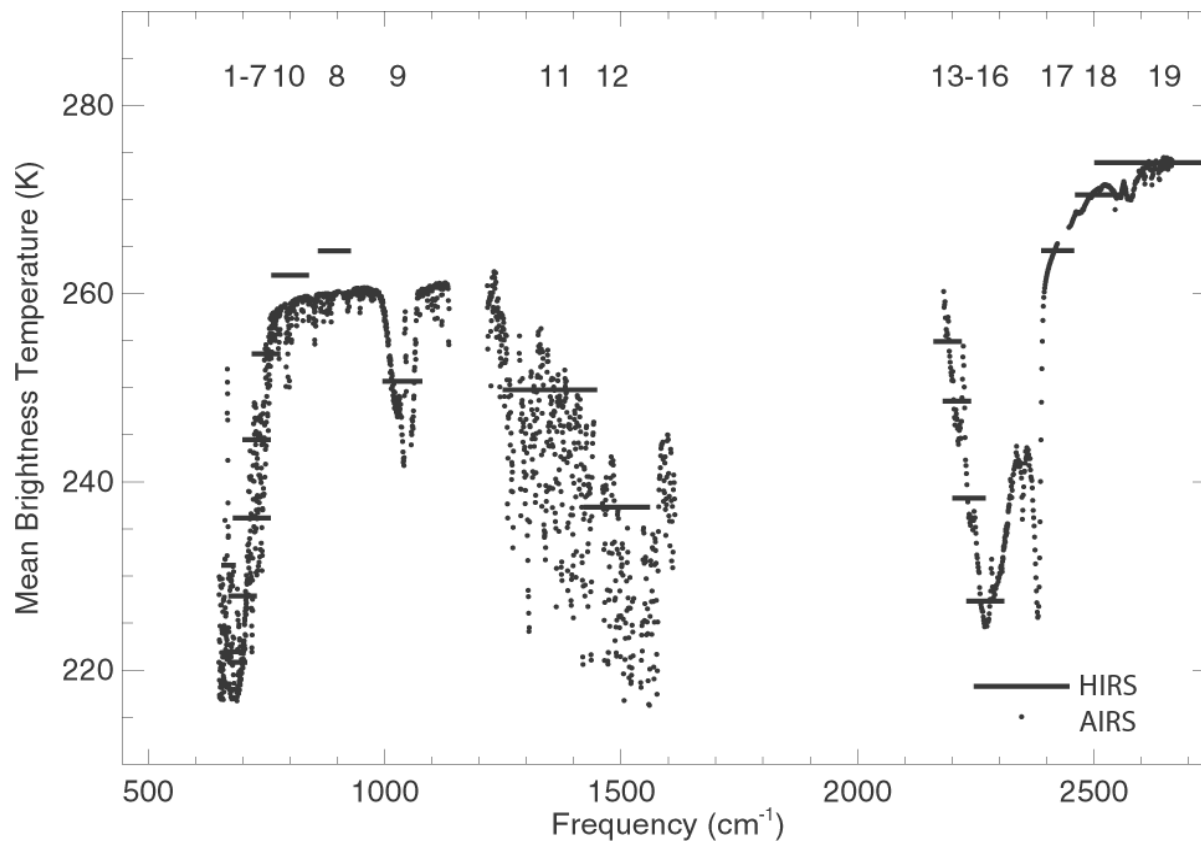


Sample SRF Fits





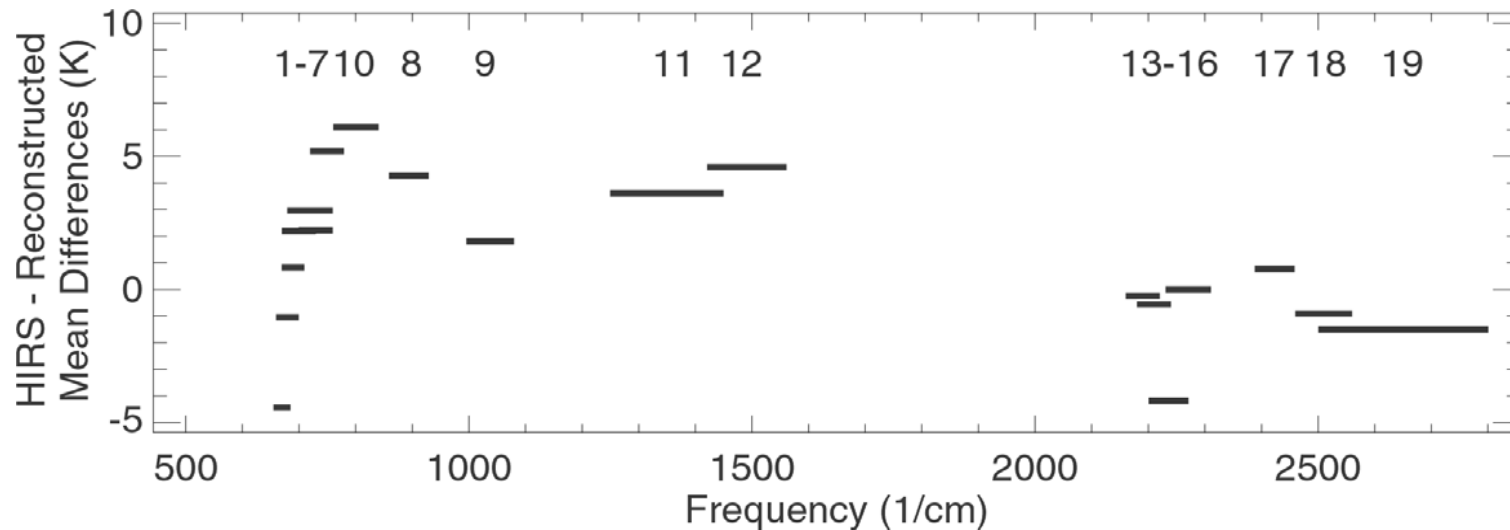
Average Brightness Temperatures





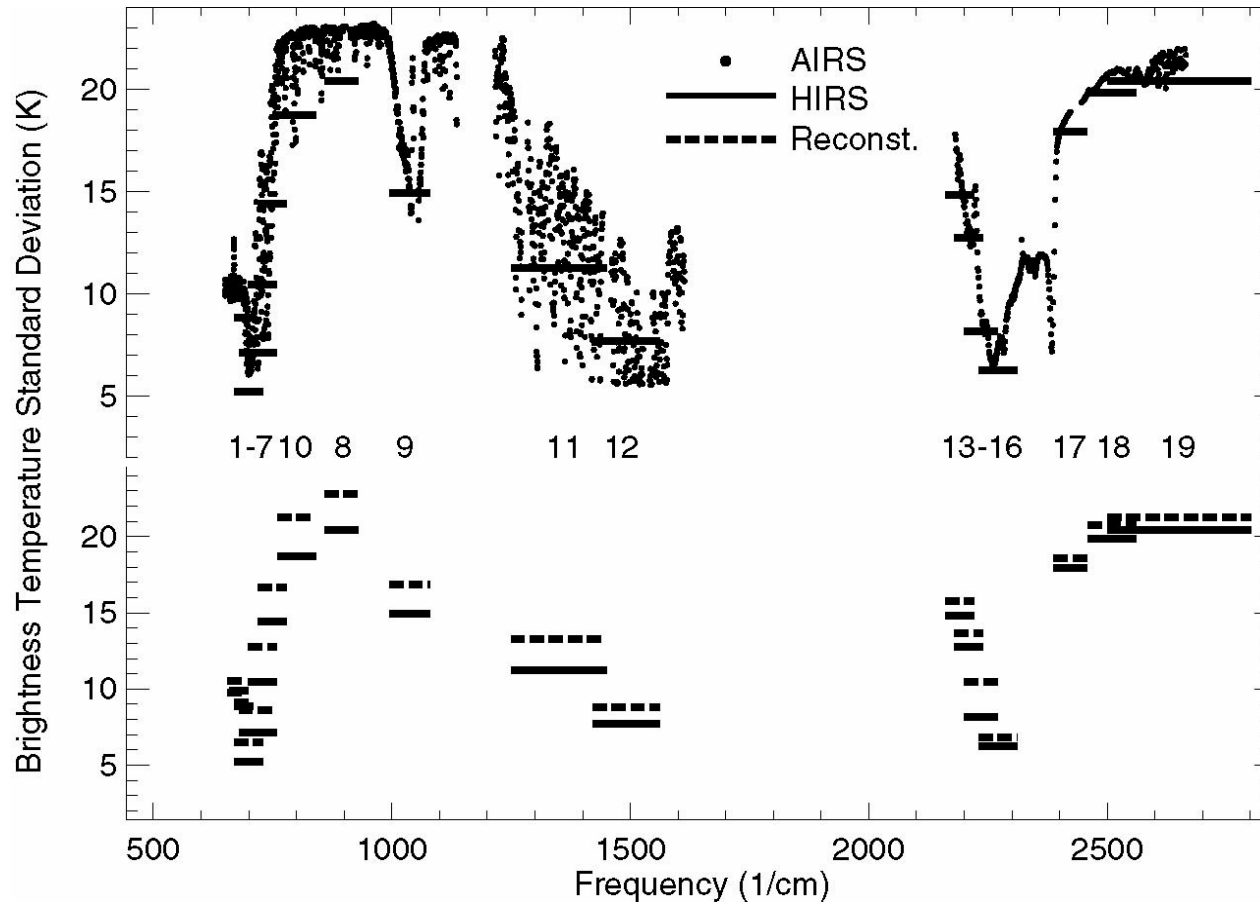
Difference of Average Brightness Temperatures

- HIRS2 - Reconstructed from AIRS simulated Radiances





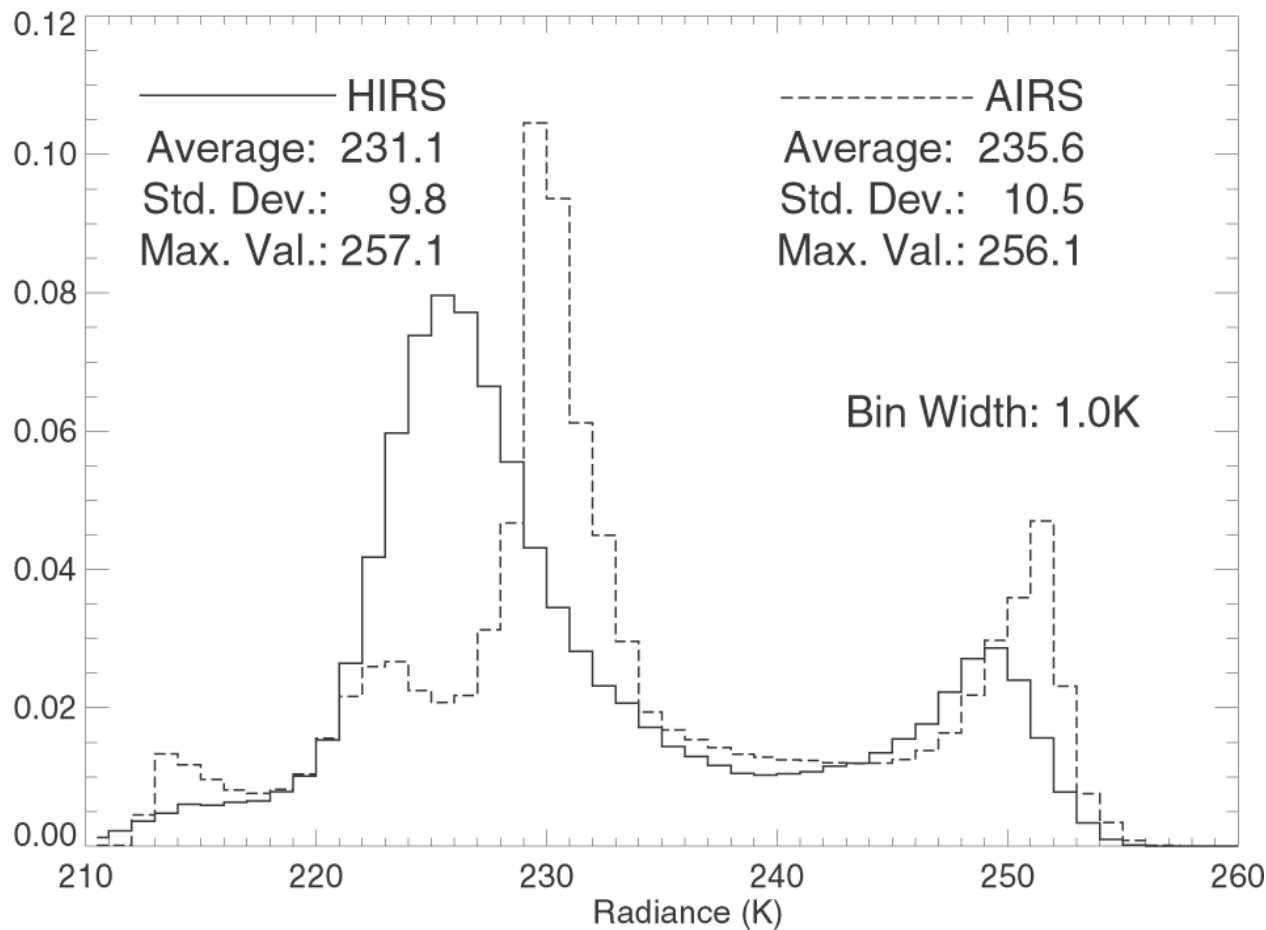
Brightness Temperature Global Variability





Channel 1 Density Function

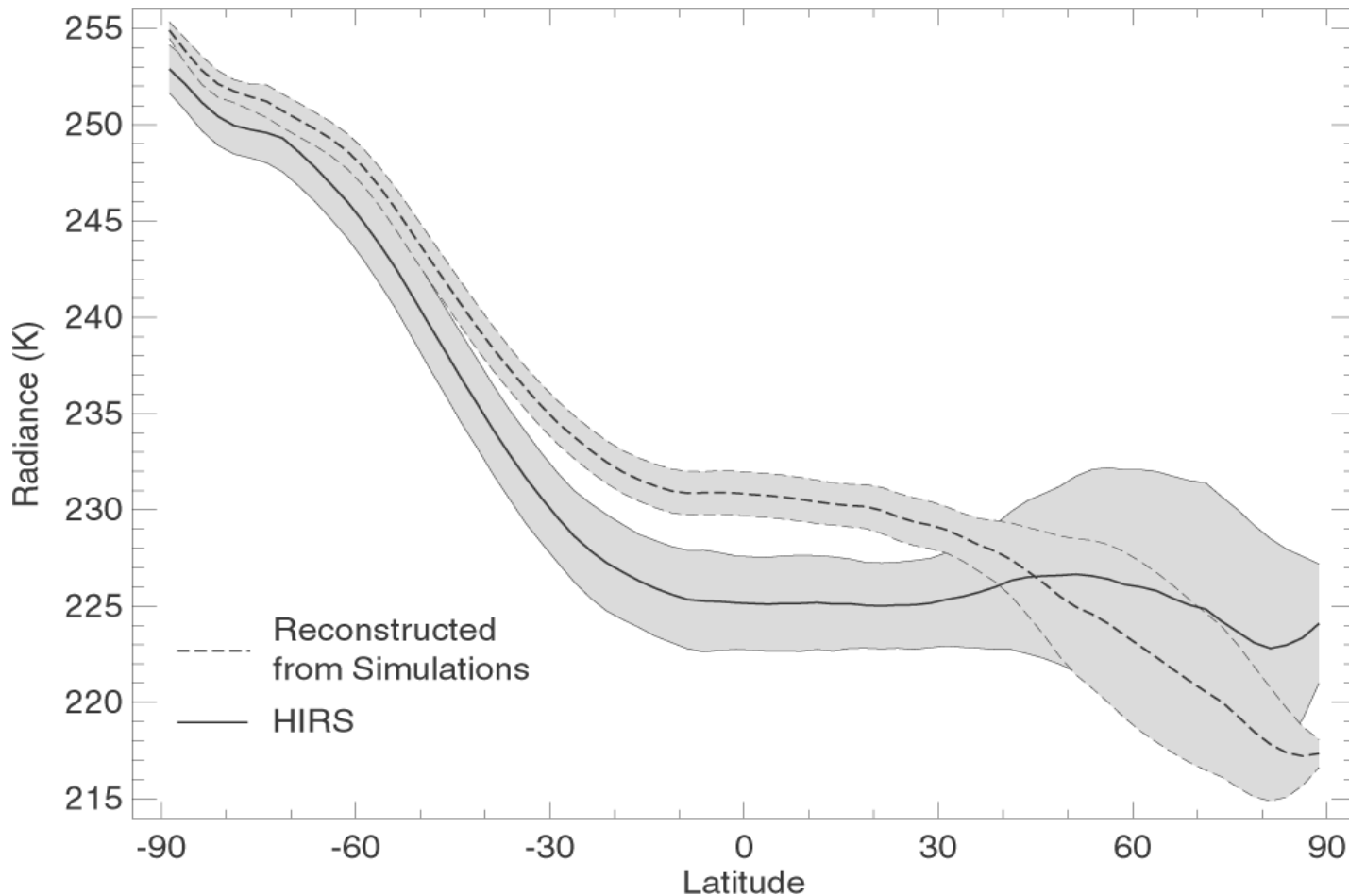
HIRS Channel 1 Radiance





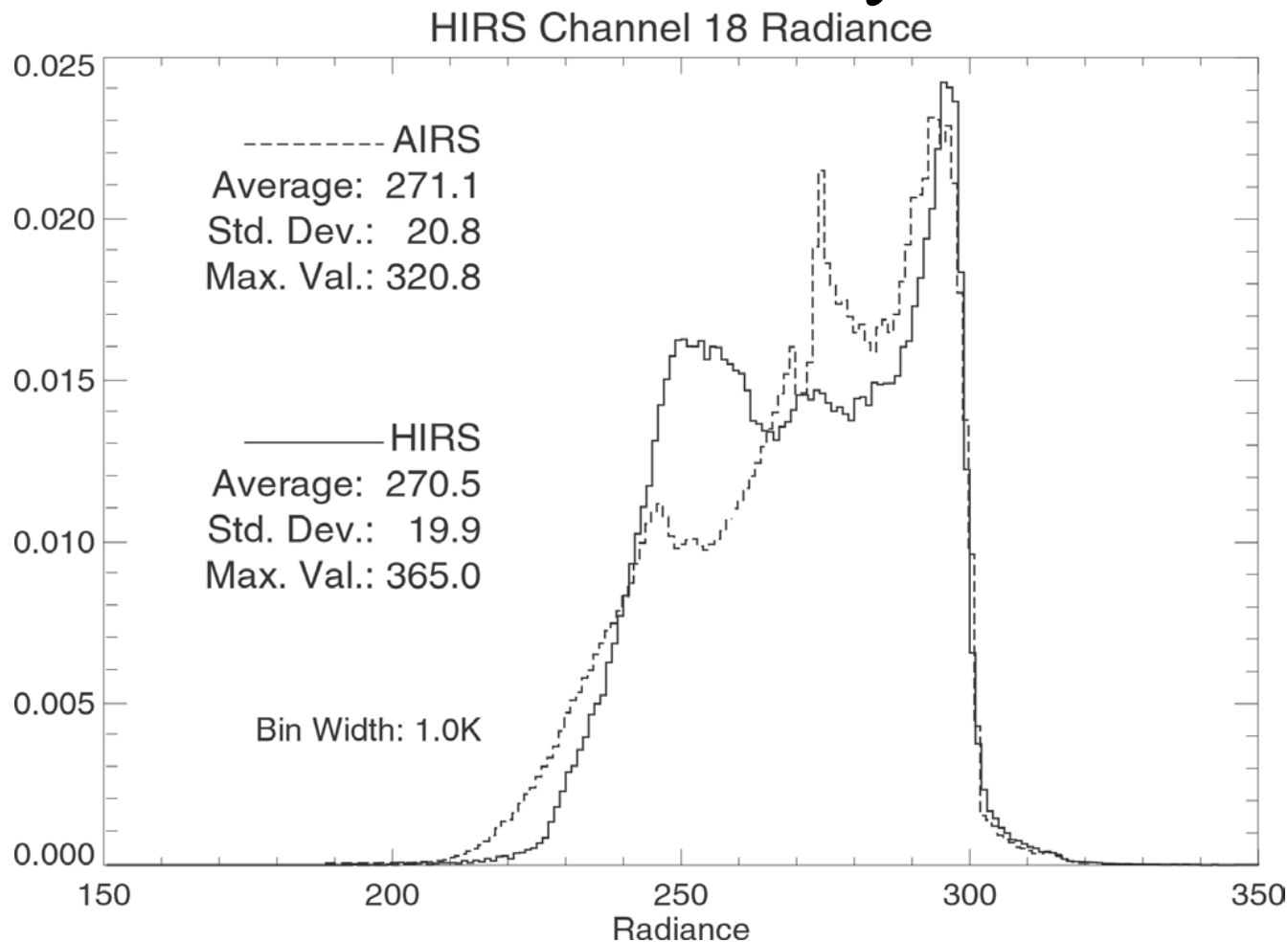
Channel 1 Zonal Variability

HIRS Channel 1 Zonal Mean Radiance



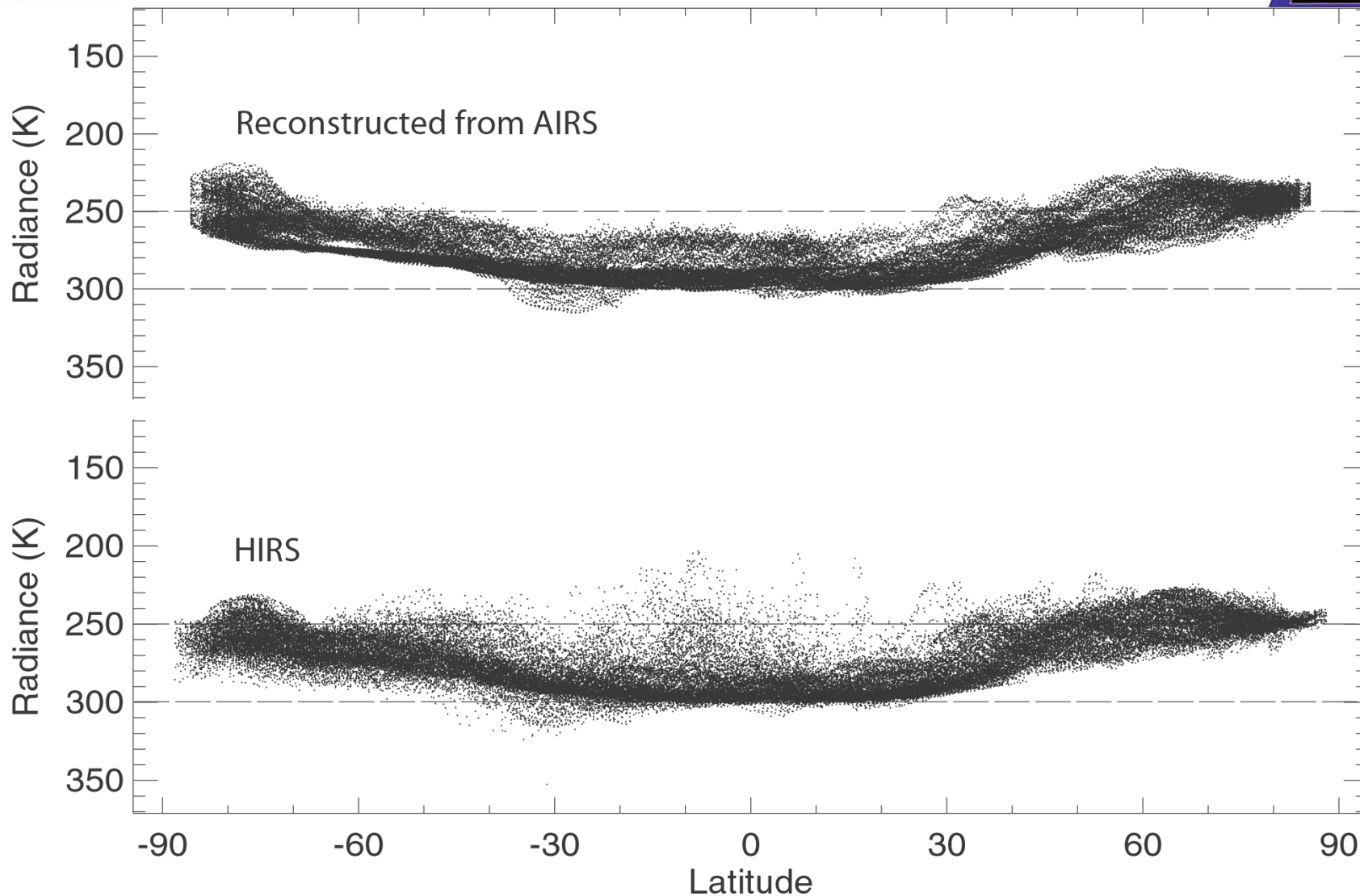


Channel 18 Density Function





Channel 18 Scatter





Conclusions

- Simulations have too little cloud at high altitude
 - new cloud model has been developed with cloud size tuning parameter to improve cloud amount and local variability
- Problem with too little water vapor
 - warm bias in simulated radiances
 - need improved water vapor (possibly ECMWF) to facilitate upper tropospheric water vapor retrieval
- Surface skin temperatures does not have enough variability over land
- Middle atmosphere temperature differs from observations but is realistic.

Agreement is Good